Claims

1. A sensor system for recording environmental data measurements, comprising:
a sensor for detecting environmental data;
a controller for controlling the operation of the sensor, including:
a front-end circuit coupled to the sensor;
a loop filter coupled to the front-end circuit;
a multiphase clock generator coupled to the front-end circuit and the loop filter; and
a startup sequencer coupled to the loop filter; and
a communication interface for coupling the sensor and the controller.

2. A controller for controlling the operation of a sensor, comprising:
a front-end circuit coupled to the sensor;
a loop filter coupled to the front-end circuit;
a multiphase clock generator coupled to the front-end circuit and the loop filter;
a startup sequencer coupled to the loop filter and the multiphase clock generator;
a sensor simulator for simulating the performance of the sensor coupled to the startup sequencer, the multiphase clock generator, and the front-end circuit; and
an overload detection device coupled to the loop filter and the startup sequencer.

3. A controller for controlling the operation of a sensor, comprising:
a front-end circuit coupled to the sensor;
a loop filter coupled to the front-end circuit;
a multiphase clock generator coupled to the front-end circuit and the loop filter;

a startup sequencer coupled to the loop filter and the multiphase clock generator; and

an overload detection device coupled to the loop filter and the startup sequencer.

4. A front-end circuit for providing electrostatic forces and position sensing for a measurement mass in a sensor, comprising:

a plurality of switches for controlling the operation of the sensor; and

a sense amplifier for sensing the position of the measurement mass within the sensor.

5. A loop filter for providing control to a sensor system, comprising:

one or more integrators for providing a signal for controlling the sensor system;

one or more derivative controllers for providing a signal for controlling the sensor system;

one or more proportional controllers for providing a signal for controlling the sensor system; and

a summer for combining the signals from the integrators, the derivative controllers, and the proportional controllers.

6. A method of operating a loop filter within a sensor system, comprising:

sending a signal to the loop filter indicating an operating mode of the sensor system;

operating the loop filter in a reduced-order mode while the sensor system is operating in a start-up mode;

operating the loop filter in the reduced-order mode for a predetermined period of time after the sensor system transitions from the start-up operating mode to a sigma-delta operating mode; and

operating the loop filter in a normal mode during the sigma-delta operating mode after the predetermined period of time during which the loop filter operates in reduced-order mode.

7. A method of operating a loop filter within a sensor system, comprising:

sending a signal to the loop filter indicating an operating mode of the sensor system;

operating the loop filter in a reduced-order mode while the sensor system is operating in a start-up mode;

operating the loop filter in the reduced-order mode for a predetermined period of time after the sensor system switches from the start-up operating mode to a sigma-delta operating mode;

operating the loop filter in the reduced-order mode while the sensor system is operating in the sigma-delta operating mode; and

operating the loop filter in a normal mode while the sensor system operates in the sigma-delta operating mode after the predetermined period of time during which the loop filter operates in reduced-order mode.

8. A method of controlling the operation within a sensor system of a loop filter including one or more integrators, a proportional controller, and a derivative controller, comprising:

sending a signal to the loop filter indicating the operating mode of the sensor system;

holding the integrators in a reset mode to place the loop filter in a reduced-order operating mode when the sensor system is operating in a start-up mode; and

taking the integrators out of the reset mode to place the loop filter in a normal operating mode when the sensor system is operating in a sigma-delta operating mode.

9. A method of placing a loop filter including one or more integrators, a proportional controller, and a derivative controller in a reduced-order operating mode, comprising:
sending a signal to the loop filter to control the operating mode of the loop filter;
holding the integrators within the loop filter in a reset mode to place the loop filter in the reduced-order operating mode.

10. A method of providing control to a sensor assembly, comprising:
determining an operating mode of the sensor assembly;
adjusting a mode of operation of a loop filter in the sensor assembly;
providing feedback loop compensation to the sensor assembly during a start-up mode of operation for the sensor assembly; and
providing noise shaping to the sensor assembly during a sigma-delta mode of operation for the sensor assembly.

11. A multiphase clock generator for providing clock signals for controlling the operation of a sensor system, comprising:
a digital signal generator; and
a data-independent clock resynchronization circuit coupled to the digital signal generator.

12. A sensor simulator for simulating the operation of a sensor, comprising:
a filter adapted to receive one or more input signals and generate an output signal representative of the operating state of the sensor; and
an input signal selector operably coupled to the filter adapted to controllably select the input signals as a function of the simulated operating state of the sensor.

13. A system for testing the operation of a controller in a sensor system, comprising:
a sensor simulator for simulating the operation of a sensor; and
a controller coupled to the simulator.

14. A method of controlling the operation of a sensor system, comprising:
using a controller to apply electrostatic forces to a sensor to create one or more sensor operating states; and
sequentially arranging the operating states into which the sensor is placed to create one or more operating modes for the sensor system.

15. A feedback control system for providing control to a sensor system, comprising:
a startup sequencer for selecting the mode of operation of the feedback control system; and
a loop filter coupled to the startup sequencer.

16. A multiphase clock generator for generating clock signals for use within a sensor system, comprising:
a digital signal generator for generating a first clock signal; and
a clock resynchronization circuit coupled to the digital signal generator for receiving the first clock signal from the digital signal generator and resampling the first clock signal to generate a second clock signal.

17. A clock resynchronization circuit for resampling clock signals, comprising:
a plurality of inverters;
a plurality of NOR gates coupled to the inverters;
a plurality of NAND gates coupled to the inverters;
a plurality of XNOR gates coupled to the NAND gates and the inverters;

a plurality of asynchronous set double-edge flip-flops coupled to the NOR gates; and

a plurality of asynchronous reset double-edge flip-flops coupled to the NOR gates.

18. A device for resampling an input signal on a rising edge and a falling edge of a clock signal, comprising:

a plurality of transmission gates;

one or more NOR gates coupled to the transmission gates; and

a plurality of inverters coupled to the NOR gates and the transmission gates.

19. A device for resampling an input signal on a rising edge and a falling edge of a clock signal, comprising:

a plurality of transmission gates;

one or more NAND gates coupled to the transmission gates; and

a plurality of inverters coupled to the NAND gates and the transmission gates.

20. A method of generating a clock signal for a sensor assembly, comprising:

generating a first clock signal; and

resampling the first clock signal to generate a second clock signal to restore signal integrity and provide a timing relationship.

21. A method of resampling an input signal, comprising:

resampling the input signal in a first level-sensitive latch, including one or more transmission gates, one or more NOR gates, and one or more inverters, on one edge of a clock input signal; and

resampling the input signal in a second level-sensitive latch, including one or more transmission gates, one or more NOR gates, and one or

more inverters, acting in parallel with the first level-sensitive latch, on another edge of the clock input signal.

22. A method of resampling an input signal, comprising:
resampling the input signal in a first level-sensitive latch, including one or more transmission gates, one or more NAND gates, and one or more inverters, on one edge of a clock input signal; and
resampling the input signal in a second level-sensitive latch, including one or more transmission gates, one or more NAND gates, and one or more inverters, acting in parallel with the first level-sensitive latch, on another edge of the clock input signal.

23. A method of operating an analog control circuit, comprising:
generating a first clock signal;
resampling the first clock signal to generate a second clock signal to restore signal integrity and provide a proper timing relationship; and
driving the analog control circuit using the second clock signal.

24. A controller assembly, comprising:
a sensor;
a sensor simulator for simulating the operation of the sensor;
a controller for controlling the sensor and the sensor simulator; and
a switch for coupling the controller to the sensor or the sensor simulator.

25. A method of testing a controller in a controller assembly, comprising:
connecting a sensor simulator to the controller;
supplying an input signal of a known value to the sensor simulator;
converting the input data to the sensor simulator into an output stream from the sensor simulator;

sending the output stream from the sensor simulator to the controller;
processing the output stream from the sensor simulator within the controller to create an output stream from the controller; and
analyzing the output from the controller to determine the accuracy of the controller.

26. A method of fabricating a controller assembly for a sensor, comprising:
providing a substrate;
fabricating one or more controllers on the substrate;
fabricating one or more sensor simulators on the substrate; and
coupling the controller and the sensor simulator.

27. A method of offsetting the effects of external acceleration forces on a sensor, independent of an orientation of the sensor, comprising:
applying electrostatic forces to the sensor to offset the effects of the acceleration force.